

REMARKS/ARGUMENTS

Favorable reconsideration of this application in light of the following discussion is respectfully requested.

Claims 1, 3, 11, 18, 20, 22, and 40-43 are presently active. Claims 2, 4-10, 12-17, 19, 21, and 23-39 are withdrawn. Claims 27-39 have been canceled without prejudice.

Claim 18 has been presently amended to address an informality noted in the Office Action.

No new matter was added.

In the Office Action, Claim 18 was objected to. Claims 1, 3, 11, 18, 20, 22, and 40-43 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,556,500 to Hasegawa et al in view of Kumar et al (U.S. Pat. No. 7,227,097).

Entry of Amendment: This amendment is submitted in accordance with 37 C.F.R. § 1.116 which permits entering of amendments canceling claims, complying with any requirement of form expressly set forth in a previous Office Action, presenting rejected claims in better form for consideration on appeal, or presenting amendments touching on the merits upon a showing of good and sufficient reasons why the amendment is necessary and was not presented earlier. The present amendment addresses a minor informality regarding Claim 18 and points out why the present claims are non-obvious, thereby placing the presently active claims in a condition for allowance. It is therefore respectfully requested that the present amendment be entered under 37 C.F.R. § 1.116.

Claim 1 as previously presented recited:

1. A processing element for a semiconductor manufacturing system, said processing element comprising:
 - a cylindrical unit including a passive polymeric component and an active component;
 - said cylindrical unit having a first radially-extending surface and a second radially extending surface opposite the first radially-extending surface,

wherein an inside diameter of the cylindrical unit forms an opening for disposition of the cylindrical unit around a substrate position in the semiconductor manufacturing system and the second radially extending surface is a substantially planar surface for disposition on a substrate holder in the semiconductor manufacturing system;

 said passive polymeric component configured to *erode when exposed to a plasma process in said semiconductor manufacturing system*; and

 said active component included as a part of said passive component and configured to alter the chemistry of the processing when exposed to the plasma process. [Emphasis added.]

As previously noted in the last filed response and as repeated below for the sake of convenience, Hasegawa et al **teach away** from an alteration of their focus ring to have components which would erode when exposed to a plasma process. Further, an alteration of Hasegawa et al would **render Hasegawa et al unsatisfactory for its intended purpose**. These points (either of which would indicate the non-obviousness of the claims) should be reconsidered in light of the discussions below.

Reasons for Non-obviousness:

1) Hasegawa et al clearly state at col. 1, lines 25-33, that:

 A focus ring (electric field compensating ring) is provided to surround the wafer on the lower electrode, thereby to effectively direct the reactive ions onto the wafer. It is necessary that the focus ring have anti-corrosion properties (*anti-chemical properties with high resistance to etching gas*), anti-plasma properties, heat resistance and electrical conductivity. From this standpoint, a ring formed integrally of amorphous carbon is generally used as a focus ring.

Meanwhile, the claimed invention sets forth:

 a cylindrical unit including a passive polymeric component and an active component, with the polymeric component configured to erode when exposed to a plasma process in said semiconductor manufacturing system.

Thus, the polymeric, erodible properties of the claimed cylindrical unit are the **opposite** of the electrical conductivity, resistant to etching gas properties of the focus ring(s) in Hasegawa

et al. For example, the focus ring structures in the embodiments of Hasegawa et al are either made of carbon or tungsten, both of which have a high resistance to etching gas, are heat resistant, and are electrically conductive, and all of which would not be an erodable polymeric component.

The Court in In re Gurley, 31 USPQ2d 1130 (Fed. Cir. 1994) stated that:

A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or ***would be led in a direction divergent from the path that was taken by the applicant***. The degree of teaching away will of course depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant. [Emphasis added.]

Here, a person of ordinary skill, upon reading Hasegawa et al, would be led in a direction divergent from the path that was taken by the applicant (i.e., Hasegawa et al teach ***anti-chemical properties with high resistance to etching gas*** which leads away from the claimed polymeric component configured to erode when exposed to a plasma process in said semiconductor manufacturing system).

Thus, Hasegawa et al ***teach away*** from the claimed invention.

2) While Hasegawa et al may use materials for the focus ring which are made of materials similar to that being etched on the wafers (see TABLE 1 of Hasegawa et al), the purpose of such materials is not to promote for example tungsten etching of a tungsten focus ring. The Examiner will appreciate that any tungsten etching of a tungsten focus ring would take away reactive species which would otherwise be available to etch tungsten lines on the wafers. Indeed, the “SAMPLE 2” results in Hasegawa et al’s Figure 5 (for a single focus ring made entirely of tungsten) shows a reduction in the etching rate toward the periphery of the

wafer, which contrasts with the wafer etching rate when the focus ring is made entirely of amorphous carbon (i.e., “SAMPLE 1”).

Indeed, one of Hasegawa et al’s solutions is to use a two part focus ring 102 with an inner part made of carbon and an outer part made of tungsten to mitigate depletion of the reactive tungsten species. Another of Hasegawa et al’s solutions is to use a single focus ring 208d made of amorphous carbon, shown in Figure 8 spaced somewhat apart from the wafer. Both these solutions appear (as in Figure 5) are directed to improving the etching uniformity across the wafer surface.

Yet, modifying the focus ring of Hasegawa et al, as suggested in the Office Action, to produce an erodible focus ring, would deplete plasma species and distort the wafer etching profile.

Hence, modifying the focus ring of Hasegawa et al, as suggested in the Office Action, would render Hasegawa et al unsatisfactory for its intended purpose. Under M.P.E.P. § 2143.01 V, this is also an indicia of non-obviousness.

3) M.P.E.P. § 2142 indicates:

The ultimate determination of patentability is based on the entire record, by a preponderance of evidence, with due consideration to the persuasiveness of any arguments and any secondary evidence. *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). The legal standard of “a preponderance of evidence” requires the evidence to be more convincing than the evidence which is offered in opposition to it. With regard to rejections under 35 U.S.C. 103, ***the examiner must provide evidence which as a whole shows that the legal determination sought to be proved (i.e., the reference teachings establish a prima facie case of obviousness) is more probable than not.***

Here, as a whole, Hasegawa et al do not disclose or suggest the claimed polymeric, erodible cylindrical unit. Indeed, the arguments above show that Hasegawa et al teach away from the attributes of an erodible polymeric focus ring. Moreover, modifying the focus ring

of Hasegawa et al to make their focus ring erodible would deplete the gas phase species, rendering Hasegawa et al unsatisfactory for its intended purpose of uniform etching.

Thus, Claims 1 and 18 (and the claims dependent therefrom) patentably define over the applied art.

Rebuttal of Examiner's Latest Position

A.) In the outstanding final Office Action, the Examiner indicated that:

In regards to Applicant's arguments against the teachings of Hasegawa et al, these arguments are not persuasive. Specifically in regards to Applicant's argument that Hasegawa et al teaches away from providing a single focus ring, this argument is not persuasive. Examiner recognizes that Hasegawa et al teaches certain advantages in providing separate focus rings, as described in the passage cited by Applicant. However, Hasegawa et al additionally teaches embodiments comprising only a single focus ring, for example the embodiment of Figure 8. Thus Hasegawa et al cannot be considered to teach away from providing only a single focus ring around the substrate.

In response, Applicants point out that argument numbered “2)” above was made not to suggest that Hasegawa et al taught away from a single focus ring, but rather to show that modifying the focus ring of Hasegawa et al to include an erodible component (as the Examiner suggested) would distort the plasma uniformity by depletion of the plasma species near the focus ring and thus distort the etch profile, making Hasegawa et al unsatisfactory for its intended purpose.

B.) In the outstanding final Office Action, the Examiner indicated that:

In regards to Applicant's argument that Hasegawa et al teaches that it is necessary that the focus ring have “anti-corrosion properties (anti-chemical properties with high resistance to etching gas)...[and] heat resistance”, and that therefore Hasegawa et al teaches away from an erodible polymeric component, this argument is not persuasive. The teachings of Hasegawa et al upon which Applicant relies as teaching away from the claimed invention are part of the *background* of Hasegawa et al, i.e. the prior art upon which Hasegawa et al seeks to improve. Contrary to Applicant's assertion that the

inventive focus ring structures of Hasegawa et al must be formed of a material having a high resistance to etching gas, and are therefore contrary to the instantly claimed invention, Hasegawa et al teaches a focus ring that erodes when exposed to plasma (see at least column 9, lines 36-47, which explains that a ring will erode when exposed to the plasma; and column 10, line 65 - column 11, line 2).

In response, Applicants point out below the deficiencies in the cited sections of Hasegawa et al.

Hasegawa et al, at col. 9, lines 36-47, states:

As has been described above, the in-plane uniformity of etching characteristics such as etching rate and etching anisotropy can be improved by employing the focus ring 102 comprising a compound structure of inner and outer parts 104 and 106 and selecting the specific materials of the inner and outer parts. The inner part is formed of an electrically conductive material, e.g. amorphous carbon, which causes substantially no reaction product by contact with an etching gas, or an electrically conductive material which does not cause, at least, any reaction product which is substantially adsorbed on an etching target, by contact with an etching gas. The outer part is formed of a material containing a component which is a main component of the etching target and causes such a reaction product as to be substantially adsorbed on the etching target by contact with an etching gas, preferably, a metallic material.

Here, the description here of an amorphous carbon “which causes substantially no reaction product by contact with an etching gas” or the material of the outer part “which . . . causes such a reaction product as to be substantially adsorbed on the etching target by contact with an etching gas, preferably, a metallic material” in no way discloses or suggests an erodable focus ring component.

Hasegawa et al, at col. 10, line 65, to col. 11, line 2:

A focus ring 208d of, e.g. amorphous carbon is situated on the support surface of the first susceptor 208a so as to surround the electrostatic chuck sheet 212 and wafer S, thereby efficiently radiating a generated plasma on the surface to be processed.

Here, the description here of an amorphous carbon “situated on the support surface of the first susceptor 208a so as to surround the electrostatic chuck sheet 212 and wafer S” also in no way discloses or suggests an erodable focus ring component.

C.) In the outstanding final Office Action, the Examiner indicated that:

Additionally, the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981). In the instant case, while Hasegawa et al alone does not teach that the erodible component is a polymeric component, Examiner maintains that one of ordinary skill in the art, *taking the combined teachings of Hasegawa and Kumar et al into consideration*, would have found it obvious, with a reasonable expectation of success in obtaining the predictable and desirable result of releasing the active component of Kumar et al by erosion of the passive component of Kumar et al, to replace one or both of the focus rings 104, 106 of Figure 1 taught by Hasegawa et al or the focus ring 208d of Figure 8 taught by Hasegawa et al with the ring comprising an active material embedded in a passive material as taught by Kumar et al.

In response, Applicants point out below that all the descriptions in Kumar et al appear to be directed to the introduction of their plasma catalyst for the express purpose of plasma ignition. Kumar et al for example describe at col. 7 that:

Consistent with this invention, a plasma apparatus may include a plasma catalyst that is located proximate to a plasma cavity. The catalyst can cooperate with the radiation to cause a gas to form a plasma. Also, as used herein, the phrase “proximate the cavity” means either within the cavity or at a location sufficiently close to the cavity to effect the formation of the plasma.

Kumar et al for example further describe at col. 9 that:

One method of forming a plasma consistent with this invention can include subjecting a gas in a cavity to electromagnetic radiation having a frequency less than about 333 GHz in the presence of a passive plasma catalyst. A passive plasma catalyst consistent with this invention can include any object capable of inducing a plasma by deforming a local electric field (e.g., an electromagnetic field) consistent with this invention, without necessarily adding additional energy through the catalyst, such as by applying an electric voltage to create a spark.

A passive plasma catalyst consistent with this invention can also be a nano-particle or a nano-tube. As used herein, the term “nano-particle” can include any particle having a maximum physical dimension less than about 100 nm that is at least electrically semi-conductive. Also, both single-walled and multi-walled carbon nanotubes, doped and undoped, can be particularly effective for igniting plasmas consistent with this invention because of their exceptional electrical conductivity and elongated shape. The nanotubes can

have any convenient length and can be a powder fixed to a substrate. If fixed, the nanotubes can be oriented randomly on the surface of the substrate or fixed to the substrate (e.g., at some predetermined orientation) while the plasma is ignited or sustained.

Thus, if the plasma catalyst of Kumar et al were placed on a focus ring, the plasma activation medium in the plasma catalyst of Kumar et al would deform the local electric field and thereby effect the plasma uniformity, contrary to the purposes of Hasegawa et al.

M.P.E.P. § 2143.01 V indicates that:

If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984)

Thus, based on the facts of the record, a modification of Hasegawa et al to include the plasma catalyst of Kumar et al would render Hasegawa et al unsatisfactory for its intended purpose of providing a uniform plasma etch profile.

D.) In the outstanding final Office Action, the Examiner indicated that:

In regards to Applicant's argument that Hasegawa et al teaches away from having a focus ring that would readily erode, because it would readily consume the reactive species that would otherwise etch the intended portion of the wafer, this argument is not persuasive. That Hasegawa et al teaches a particular way of processing a wafer using a plasma, even what Hasegawa et al considers to be the best way of processing the wafer, does not mean that Hasegawa et al teaches away from any other plasma profile. Furthermore, the degree to which the erodible polymeric component taught by the combination of Hasegawa et al and Kumar et al would erode in the plasma, thereby consuming reactive species, would be dependent on a number of process variables, especially the type of process gas supplied to the chamber and the type of substrate to be processed, which are matters of intended use of the apparatus of Hasegawa et al and Kumar et al. The apparatus of the combination of Hasegawa et al and Kumar et al would still be structurally capable of executing uniform processing of the substrate, based up on user selection of the process variables. Moreover, the erodible polymeric component of the combination of Hasegawa et al and Kumar et al releases the active component into the plasma, which would be expected by one of ordinary skill in the art to provide a benefit of adding a desired chemical to the plasma, a benefit which would be expected to offset any corresponding loss in

the active species used to etch the passive polymer to release the active component.

In response, Applicants point out that the Examiner's position appears to be speculative and contrary to the facts of Hasegawa et al. The PTO reviewing court has recently explained again the need for reliance on substantial evidence from the record in In re Gartside, 203 F.3d 1305, 1315 (Fed. Cir. 2000) ("Because our review of the Board's decision is confined to the factual record compiled by the Board ... the 'substantial evidence' standard is appropriate for our review of Board fact findings. *See* 5 U.S.C. §706(2)(E)."). Also note In re Zurko, 258 F.3d 1379, 1386, 59 USPQ2d 1693, 1698 (Fed. Cir. 2001) as follows:

With respect to core factual findings in a determination of patentability, however, the Board cannot simply reach conclusions based on its own understanding or experience — or on its assessment of what would be basic knowledge or common sense. Rather, the Board must point to some concrete evidence in the record in support of these findings.

There is no evidence in the record to support the Examiner's position that the erodible polymeric component of the combination of Hasegawa et al and Kumar et al would provide a benefit ***which would be expected to offset any corresponding loss in the active species*** used to etch the passive polymer to release the active component.

E.) In the outstanding final Office Action, the Examiner indicated that:

In response to Applicant's argument that the references fail to show certain features of Applicant's invention, it is noted that the features upon which applicant relies (i.e., that the combination of Hasegawa et al and Kumar et al does not teach that the focus ring is formed only of an electrically insulating material) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. *See In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). As discussed above, it would have been obvious to one of ordinary skill in the art to modify the passive polymeric ring-shaped component of Hasegawa et al and Kumar et al to comprise at least a coating of an electrically insulating polymeric material, as an electrically insulating coating is taught by Kumar et al to be an art-recognized suitable material for forming a passive component in a plasma

chamber and the newly cited reference to Kava et al teaches an electrically insulating polymeric material to be an art-recognized suitable electrically insulating material for use in a ring-shaped component in a plasma chamber.

In response, Applicant wishes to clarify that the last filed comments directed to “a focus ring be[ing] electrically conductive” were comments pointing out that the “requirements in Hasegawa et al” (i.e., that the focus ring be electrically conductive) is contrary to a focus ring made of a polymeric component (which is a claimed component).

Indeed, all of the Examiner’s comments above reinforce that the asserted combination of Hasegawa et al and Kumar et al in the outstanding Office Action comprises “at least a coating of an electrically insulating polymeric material,” which is contrary to the requirement in Hasegawa et al that the focus ring be electrically conductive.

Furthermore, the newly cited art reference, Kava et al (U.S. Pat. No. 5,474,649) also teaches away from the claimed passive polymeric component configured to erode when exposed to a plasma process in said semiconductor manufacturing system. Kava et al teach a textured focus ring surface which stabilizes and retains residues, not an erodible surface. In Kava et al, the focus ring is textured to maintain a coating on the surface of the focus ring. Kava et al states at col. 3, lines 14-19, that:

Because a focus ring has proximity to the workpiece/surface substrate and, consequently, is more susceptible to contaminant build-up in plasma etch processing, it is desirable to provide a focus ring which accommodates and stabilizes coatings of contaminant residues and requires less frequency of cleaning.

Furthermore, Kava et al states at col. 7, lines 56-66, that:

The above illustrations indicate that employing the texturized focus rings of the present invention will result in an improved contaminant control than otherwise obtainable with untexturized focus rings in that the uniform coating on the inner ring surface will more effectively prevent residue flaking onto a semiconductor workpiece during etch processing. Moreover, these rings will work more efficiently in that uniform coating of contaminant can be allowed to accumulate without contaminant risk to the workpiece and the

texturized ring will require cleaning or replacement less often than ordinarily expected with an untexturized ring.

Thus, for all these reasons stated above (any of which would make the claims non-obvious), Claims 1, 3, 11, 18, 20, 22, and 40-43 should be found non-obvious and passed to allowance.

In light of the above discussions, the outstanding grounds for rejection are believed to have been overcome. The application is believed to be in condition for formal allowance. An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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